1 We claim:

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1 1. In a digital signal receiver for a communication system, a method

2 for processing a multi-dimensional digital signal received from a

3 communication channel, the multidimensional signal including encoded data

4 symbols, each encoded data symbol being represented by a number of sub-

5 symbols in different dimensions of the multi-dimensional signal, the method

6 comprising:

7   encoding each sub-symbol in the multidimensional signal by

8   extracting sufficient information associated with the sub-

9   symbol for subsequent processing;

10   performing a pair-swap and symbol alignment operation on the

11   encoded multidimensional signal; and

12   decoding the pair-swap reordered and symbol aligned

13   multidimensional signal to produces data symbols represented

14   by the sub-symbols in an output signal.

1 2. A digital signal receiver for reordering a multi-dimensional signal

2 received from a communication channel, the multidimensional signal

3   including encoded data symbols, each encoded data symbol being

4   represented by a number of sub-symbols in different dimensions of the

5   multi-dimensional signal, comprising:

6   a slicer configured to quantize the sub-symbols in the

7   multidimensional digital signal to a quantized value;

8   an encoder operating in conjunction with the slicer unit and

9   configured to encode each sub-symbol to include the quantized

10   value and neighborhood information associated with the sub-

11   symbol;

12   a pair-swap and symbol alignment module coupled to the

13   slicer/encoder and configured to detect and correct pair-swap

14   and symbol misalignment in the multidimensional digital

15   digital; and

16   at least one decoder coupled to the pair-swap and symbol alignment

17   module configured to receive the pair-swap reordered and

18   symbol aligned multidimensional signal, to decode the sub-

19   symbols in the multidimensional signal, to correct errors

20   associated with these sub-symbols, and to produce decoded

21   symbols represented by the sub-symbols in an output signal.

1   3. The digital receiver of claim 2, wherein the encoder operates to

2   encode the quantized value and neighborhood information associated with

3   each sub-symbol by extracting compact yet sufficient information for

4   subsequent processing of the multidimensional signal.

1   4. The digital receiver of claim 3, wherein each sub-symbol before

2   the slicer is represented by one sign bit, a first and a second magnitude bits

3   and three fractional bits, and the encoder encodes each sub-symbol by

4   extracting the sign bit, the second magnitude bit, and the three fractional bits

5   to represent the encoded sub-symbol.

1   5. The digital receiver of claim 2, wherein the multidimensional

2   signal includes a data part and a non-data part preceding the data part, and

3   the pair swap and symbol alignment unit further comprising

4   a converter configured to convert each encoded sub-symbol in the

5   non-data part of the multidimensional signal into binary format;

6   a non-data mode receiver coupled to the converter and configured to

7   detect pair-swap and symbol misalignment in the

8   multidimensional signal using the non-data part of the

9   multidimensional signal in binary format as received from the

10   converter; and

11   a switchboard module coupled to the non-data mode receiver

12   configured to correct pair-swap and symbol misalignment in the

13   multidimensional signal based on information regarding pair-

14   swap and symbol misalignment in the multidimensional signal

15   as detected by the non-data mode receiver.

1   6. The digital receiver of claim 5, wherein the non-data mode receiver

2 detects pair-swap and symbol misalignment in the multidimensional signal

3 by serially comparing selected bits from each dimension of the non-data part

4 of the multidimensional signal with a set of scrambler coefficients.

1   7. The digital receiver of claim 5, wherein the switchboard module

2 corrects pair-swap and symbol misalignment in the multidimensional signal

3 by performing symbol alignment and pair-swap reordering operations in one

4 pass.

1   8. The digital receiver of claim 5, wherein the switchboard module

2 operates in a verification mode and in a switching mode, verifies that

3   information regarding pair-swap and symbol misalignment detected by the

4   non-data mode receiver is correct in the verification mode, and corrects pair-

5   swap and symbol misalignment in the multidimensional signal in the

6   switching mode.